

**RULE 1186: APPENDIX A**

**South Coast Air Quality Management District Test Protocol**

**Rule 1186-Certified Street Sweeper Compliance Testing**



**September 1999**



**1 Scope** - This protocol establishes a method for determining which street sweeping equipment is considered Rule 1186-certified under the provisions of South Coast Air Quality Management District (AQMD) Rule 1186.

**1.1 Purpose** - The purpose of this document is to describe a test protocol for gauging the PM10-efficiency of street sweeping equipment and to establish procedures to present test results. PM10-efficiency includes both the equipment's ability to remove typical urban street loadings and limit the amount of PM10 entrained during the sweeping process.

## **2 References**

**2.1 Test Methods** - U.S. Environmental Protection Agency (EPA) reference test methods as established by 40 Code of Federal Regulations (CFR), Part 50, Appendix J, or EPA-published documents for EPA-approved equivalent methods for conducting particulate matter measurements (see Section 3.5). Any particulate matter air monitoring equipment used in the sweeper tests shall also be subject to prior approval by the AQMD.

## **3 Definitions**

**3.1 Street Sweeping Equipment** - A self-propelled sweeper that is primarily designed to remove material from highways, arterials, collectors, and local roadways. Street sweeping equipment may use a broom or air stream to dislodge and direct material into a collection mechanism, that may be mechanical, pneumatic, or a combination of both systems to convey the swept material into a collection hopper.

**3.2 Test Track** - A level area (less than or equal to 3%) covered with asphalt (or equivalent) with roughness typical of paved roads on which the sweeping test is conducted that extends a minimum of 200 feet [61 meters] through an enclosed tunnel or building with a maximum height of 15 feet [4.6 meters]. The test track must contain 100 feet of curbing and a surrogate, rounded profile, speed bump (maximum dimensions - two inches tall and four inches wide) shall be placed diagonal to the test track at its midpoint (Figure 1). The shape, dimensions, and location of the speed bump shall be subject to prior AQMD approval.

**3.3 Test Material** - Prepared material used in the sweeping tests that consists of 90 percent (by weight) Department of Transportation washed sand and ten percent #10 Georgia Paint Pigment (calcium carbonate).

**3.4 Test Material Density** - Test material placed on the test track at a rate of 1,000 pounds per curb mile (i.e., 38 pounds over 200 foot test track or 17.2 kilograms over a 61 meter test track) with 50 percent deposited in the first six inches [15.2 centimeters] with the remaining 50 percent placed in the adjacent 18 inches [45.7 centimeters]. The test material shall be placed adjacent to the curb for the first 100 feet (30.5 meters) of the test track and approximately two feet away from any curbing for the remainder of the test track (see Figure 1). In instances where the test track has a fixed

curb, a surrogate curb shall be installed for 100 feet to ensure that half of the material is adjacent to a curb and the remaining half is approximately two feet from the curb while ensuring that the test material is arranged in a straight line.

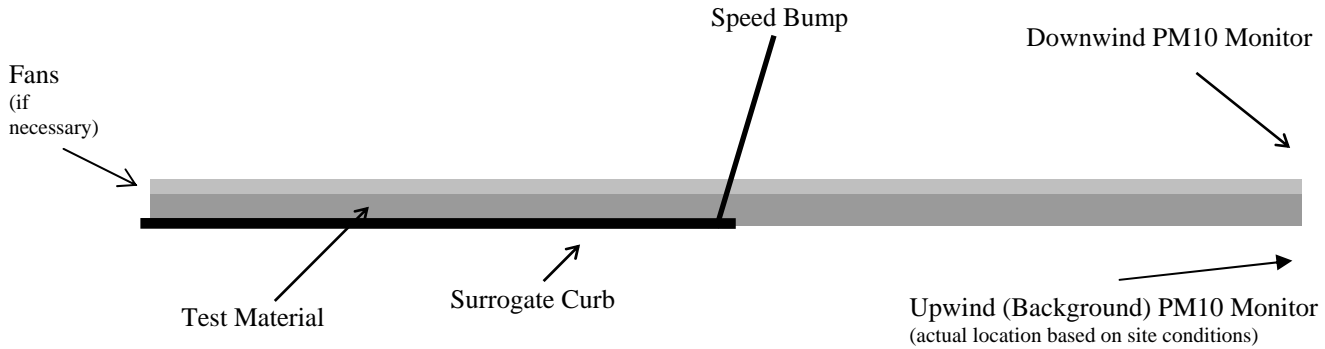


FIGURE 1 – TEST TRACK (TOP VIEW)

**3.5 Ambient Particulate Matter Air Monitoring** - Consists of air quality monitoring equipment operated, maintained, and calibrated in accordance with Section 2.1. At a minimum, one co-located PM10 monitor will be placed at the downwind end of the tunnel and one PM10 monitor shall be placed at a suitable upwind (background) site. If necessary to ensure an adequate flow rate through the test tunnel (at least one m/s, but no more than 6 m/s), four 3/4 horsepower 42-inch [106.7 centimeter] diameter fans will also be placed at the test track entrance to ensure appropriate air circulation and mixing. The size and power of the fans and the specific location of the fans and air monitoring equipment shall be based on site specific conditions and will be subject to approval by AQMD staff prior to test runs used for certification purposes.

#### **4 Technical Requirements**

**4.1 Condition of Sweeper** - Prior to each test run, the sweeper must be set at the normal operational settings according to the manufacturer's specification. Where the sweeper has variable duties of operation described in its instruction manual, then the sweeper should be operated at its maximum-duty cycle. Brooms and swept material containment curtains, etc., should be in like-new condition. These settings must be provided in the test report. Dust suppression systems, if provided, shall be active during the test.

**4.2 Weather Conditions** - Weather conditions must be dry, with wind speeds less than 12 miles per hour [6 meters per second] and such that it will not disturb test material. Weather instrumentation to measure temperature, humidity, wind speed, and wind direction shall also be required at least three feet [0.9 meters] below the test track cover.

### **4.3 Site Preparation**

4.3.1 Test Track Layout - The test track shall be oriented to be parallel with the prevailing wind direction, with the tunnel entrance in the upwind position.

4.3.2 Pre-Test Run Test Track Conditioning - Prior to the pre-test run sweeper conditioning, the sweeper shall make as many passes through the test track as deemed necessary to ensure that the test track is clean.

4.3.3 Pre-Test Run Sweeper Conditioning - The sweeper shall be conditioned by sweeping approximately 3/4 of a cubic yard of washed sand spread to a depth of approximately one inch prior to the first test run. This is to assure that all ducting and related equipment that may retain a thin film of dust are at an equilibrium condition. The pre-test run sweeper conditioning shall be made using the equipment's dust control method (e.g., water spray, dry filters, etc.) as specified by the manufacturer.

4.3.4 Test Material Pattern - Test material shall be placed on the test track in accordance with the specifications established in Section 3.4. The test track shall be scrubbed and dried prior to conducting subsequent test runs.

### **4.4 PM10-Efficient Street Sweeper Testing**

4.4.1 Test Runs - The sweeper shall start sweeping at a maximum duty cycle at least 100 yards away from the test track entrance and shall continue through the test track with the objective of removing the maximum amount of test material, subject to the other test requirements. After the first test-run, all test material shall be removed in accordance with Section 4.4.2 and the test track shall be dried prior to replacing the test material for subsequent test runs. These procedures shall be repeated until three test runs have been completed.

4.4.2 Travel Speed - During each test run, the goal is for the sweeper to travel at a minimum of five miles per hour [8 kilometers per hour]. Speed may be measured by timing each sweeper run from start to finish of each test run to verify travel speeds. The average speed from the three test runs shall be computed. Due to the difficulty in maintaining a five mile per hour speed, a minimum travel speed of four miles per hour for the average of the three test runs must be demonstrated for the test to be acceptable, with no more than one individual run below 4 mph and no individual run below 3 mph.

4.4.3 Post-Test Run Material Collection - All test material remaining on the test track shall be removed using suitable recovery equipment (e.g., modified carpet extractor or industrial scrubber). The recovery equipment must demonstrate at least an 80% test material collection efficiency *and* shall be subject to AQMD approval prior to testing and shall be thoroughly rinsed with clean water between each test material collection effort.

4.4.4 Pre-Test Sweeper Pass and Test Run Ambient Particulate Matter Air Monitoring Measurements - The background and downwind ambient PM10 monitoring equipment at the exit of the test track shall be activated at the beginning of each test run and will continue to operate for two minutes.

**5 Reporting** - At a minimum, the following information will be included with the reported results of the PM10-efficient street sweeper performance testing. Certified copies of the raw data reporting forms must also be made available to the AQMD. Calculation methodologies are presented in Section 6.

Test date:	Test reference number:	Humidity:
Manufacturer:	Machine type:	Temperature:
Model and serial number:	Travel time:	Wind speed:
Operational adjustments:		

$M_{PM10}$  (normalized mass of entrained PM10):

$N_{pick-up}$  (pick-up efficiency):

Comments:

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**6 Calculations** - Unless specified otherwise, all ambient PM measurements and material collection results shall be calculated using the methodologies listed below.

**6.1 Ambient Particulate Matter Air Monitoring Measurements:**

$$M_{PM10} = \frac{S \times U \times \int_0^{T_{\text{sampling}}} (C_{PM10, \text{test}} - C_{PM10, o}) \times dt}{L}$$

where,

$M_{PM10}$  = mass of PM10 entrained per unit length [mg/(m)]

$C_{PM10, \text{test}}$  = PM10 concentration measured at the downwind (end of the tunnel) monitor ( $\mu\text{g}/\text{m}^3$ )

$C_{PM10, o}$  = baseline PM10 concentration measured at upwind (background) monitor ( $\mu\text{g}/\text{m}^3$ )

$S$  = cross sectional area of the tunnel ( $\text{m}^2$ )

$U$  = linear speed of airflow in tunnel (meters/second)

$T_{\text{sampling}}$  = standardized duration of sampling

$L$  = distance swept [based on length of tunnel/test track for three runs] (meters)

**6.2 Material Collection:**

$$\frac{W_{\text{base}} - W_{\text{test}}}{W_{\text{base}}} \times 100 = N_{\text{pick-up}}$$

where,

$N_{\text{pick-up}}$  = pick-up efficiency (%)

$W_{\text{base}}$  = weight of test material spread over test track before the test (grams)

$W_{\text{test}}$  = weight of test material remaining on test track after test (grams)